IMAGE FORMING APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an image forming apparatus having a plurality of scanning type optical devices used in a copy machine, a printer, a facsimile, etc.

Related Background Art

Conventionally, in a scanning type optical device used in a laser beam printer (LBP), a digital copy machine, etc., light flux emitted from a light source means as light-modulated on the basis of an image signal is periodically polarized by a polarizer comprising, e.g., a rotary polygon mirror and then converged in a spot by a scanning type optical element (image forming element) having an fθ characteristic onto a surface of a recording medium (photosensitive drum) having a photosensitivity, which surface is scanned optically to record the image.

FIG. 9 is a schematic diagram for showing an important part of the above-mentioned type of a conventional scanning type optical device.

In the scanning type optical device shown in FIG. 9, divergent light flux emitted from a light source means 91 is transformed by a collimator lens 92 into roughly parallel light flux, which is in turn limited

in light quantity by a diaphragm 93 and then injected to a cylinder lens (cylindrical lens) 94 having a predetermined refracting power only in the sub-scanning direction. The roughly parallel light flux thus injected to the cylinder lens 94 is emitted as in a main scanning cross section, to be converged in a sub-scanning cross section and formed as an approximate line image on a polarizing surface (reflecting surface) 95a of a polarizer 95 comprising a rotary polygon mirror.

Thus, the polarized and reflected on the polarizing surface 95a of the polarizer 95 passes through a scanning type optical element (fθ lens) having an fθ characteristic and is guided on a photosensitive drum surface 98, which surface is then scanned optically in a direction of an arrow B when the polarizer 95 is turned in a direction of an arrow A. In such a way, an image is recorded on the photosensitive drum surface 98, which is a recording medium.

Recently, there has been proposed a color image forming apparatus having a plurality of (e.g., four) scanning type optical devices (see Japanese Patent Application Laid-Open Nos. 6-183056 and 10-186254).

A conventional color image forming apparatus, however, uses many folding mirrors and has a plurality of (e.g., four) scanning type optical devices

independently screwed to the side plate of the main body thereof, so that when those optical devices are specifically fixed to that main body, their light application positions are deviated different directions, to thereby give rise to misregistration in color, thus causing image quality deterioration.

Furthermore, since they are solidly fixed as deformed, their light application positions are deviated in different directions by environmental fluctuations, i.e. high/low temperatures, distorted mounting (where the color image forming apparatus is mounted on a distorted surface), which also gives rise to misregistration in color.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an image forming apparatus for suppressing deviations in the application position of a light emitted from an optical box, thus preventing an image from being deteriorated.

It is another object of the present invention to provide an image forming apparatus comprising an image bearing body, a light source, a polarizing means for polarizing a light emitted from the light source, a lens for imaging a light polarized by the polarizing means onto the image bearing body, and an optical box for containing at least the light source, the

polarizing means, and the lens, wherein the optical box is provided plurally and the plurality of optical boxes to be integrated.

Further objects of the present invention will become apparent from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view for showing a state where scanning type optical devices of a color image forming apparatus related to the present invention are stacked in a plurality of stages;

FIG. 2 is a plan view for showing the scanning type optical device of the color image forming apparatus related to the present invention;

FIG. 3 is a perspective view for showing an optical box of the scanning type optical device;

FIG. 4 is another perspective view for showing the optical box of the scanning type optical device;

FIG. 5 is further another perspective view for showing the optical box of the scanning type optical device;

FIG. 6 is still further another perspective view for showing the optical box of the scanning type optical device;

FIG. 7 is a perspective view for showing a method of fixing the scanning type optical device to the color image forming apparatus;

FIG. 8 is another perspective view for showing the method for fixing the scanning type optical device to the color image forming apparatus; and

FIG. 9 is a plan view for showing an important part of a conventional scanning type optical device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following will describe some embodiments of the present invention with reference to the drawings attached hereto.

FIG. 1 is a cross-sectional view for showing a state where scanning type optical devices of a color image forming apparatus related to the present invention are stacked in a plurality of stages, FIG. 2 is a plan view for showing the scanning type optical device, and FIG. 3 is a perspective view for showing an optical box.

In the color image forming apparatus relating to the present invention, as shown in FIG. 1, four scanning type optical devices 40a, 40b, 40c, and 40d are vertically stacked in a plurality of stages and respectively comprise optical boxes 36a, 36b, 36c, and 36d, which respectively include laser units 30a, 30b, 30c, and 30d for producing a roughly parallel light of a light flux emitted from light source semiconductor lasers 100a, 100b, 100c, and 100d, respectively, cylindrical lenses 31a, 31b, 31c, and 31d shown in

FIG. 2 for forming as an image a light flux on the reflection surface of rotary polygon mirrors 33a, 33b, 33c, and 33d, respectively, polarizer means 32a, 32b, 32c, and 32d for polarizing light flux 50a, 50b, 50c, and 50d, respectively for scanning, beam detecting sensors 38a, 38b, 38c, and 38d shown in FIG. 2 for sampling a write-out synchronization signal, image-forming lenses 34a, 34b, 34c, and 34d for forming as an image thus polarized light flux on image bearing bodies 37a, 37b, 37c, and 37d, respectively, and lenses 35a, 35b, 35c, and 35d.

In this embodiment, as shown in FIG. 3, at the upper part of the optical boxes 36c and 36d are provided protrusions 41c and 41d, respectively and, at the lower part of them are formed pores 42c and 42d, respectively. The protrusion 41d and the pores 42c and 42d are provided on both sides of the optical box like the protrusion 41c.

Thus, the protrusion 41d of the underlying optical box 36d is fitted into the pore 42c of the overlying optical box 36c to thereby align these two optical boxes 36c and 36d. Then, elastic member springs 39a and 39b are pushed from both sides into lateral ribs 43c2 and 43d1, which are expanded engaging portions for engagement with other optical boxes, of the optical boxes 36c and 36d, respectively, to thereby fasten these two optical boxes with each other.

The four scanning type optical devices 40a, 40b, 40c, and 40d can be fasted one another by almost the same operations as above in such a configuration employed above that the optical boxes 36a through 36d are fasted each other by use of the springs 39a and 39b to thereby fasten those four optical boxes without deformations unlike in the case of a conventional embodiment, thus avoiding fluctuations in the position of applying light flux 50a through 50d emitted from the scanning type optical devices 40a through 40d onto the image bearing bodies 37a through 37d, respectively. Moreover, even with environmental fluctuations such as high or low temperatures and skewed mounting, no residual stress is generated on the optical boxes 36a through 36d, so that such optical devices as the laser units 30a through 30d, the cylindrical lenses 31a through 31d, the polarizers 32a through 32d, and the image forming lenses 34a through 34d and 35a through 35d have no deformation or shift to thereby prevent the optical boxes 36a through 36d from being deformed or shifted, thus avoiding fluctuations in the light application positions.

Furthermore, those optical boxes can be fasted with each other by adhering them at the gap between the protrusion and the pore in place of using the spring. In addition, they can be fastened with each other by welding them at their respective protrusions.

Furthermore, as shown in FIG. 4, the lateral ribs 43c1, 43c2, 43d1, and 43d2, at which the optical boxes 36c and 36d are fixed with each other, may be provided with notches 44c and 44d, respectively, to fasten the optical boxes 36c and 36d by sandwiching the ribs 44c1 and 44c2 present between the notches of the lateral ribs 43c2 and 43d1 superposed one on the other using the springs 39a and 39b from both sides, thus avoiding deformations in the portions where such optical devices are mounted as the laser units 30c and 30d, the cylindrical lenses 31c and 31d, the polarizers 32c and 32d, and the image forming lenses 34c, 34d, 35c, and 35d to thereby suppress fluctuations in the light application positions of the scanning type optical devices 40c and 40d. Accordingly, the optical boxes 36a through 36d can be fastened with each other by almost the same fastening method as above to thereby suppress fluctuations in the light application positions of the scanning type optical devices 40a through 40d.

In this case, if an inclination distance between the scanning type optical devices 40d and 40c when the scanning type optical device 40c is mounted to the scanning type optical device 40d is within an allowable range (a few tens of micrometer (μm) approximately), the scanning type optical devices 40c and 40d may be fastened to each other according to the above-mentioned

method.

If, however, the light illumination is inclined such that the resultant misregistration in color goes out of the allowable range when the scanning type optical devices 40a through 40d are simply stacked one on another, the inclination can be adjusted according to the following procedure to then properly the scanning type optical devices 40a through 40d one another.

By fixing, in FIG. 5, one side of the lateral rib 43c2 provided to the optical box 36c as measuring the light application positions (light flux 50c1 and 50c2) of the scanning type optical device 40c with respect to the light application positions (light flux 50d1 and 50d2) of the scanning type optical device 40d to then adjust the light application positions by moving the other side of the lateral rib 43c2 vertically in a C-C' direction in order to stop the optical box 36c at a predetermined position, an adhesive agent can be then poured into a gap between the protrusion 42c and the pore 42d to thereby fix the optical boxes 36c and 36d to each other.

The following will describe a method for once fixing the scanning type optical devices 40a through 40d to their respective members with respect to FIG. 6.

A storage member 60, which is a positioning means, for the scanning type optical devices 40a through 40d

is provided with inner ribs 61a1, 61a2, 61b1, 61b2, 61c1, 61c2, 61d1, and 61d2, so that when the scanning type optical device 40d is to be mounted for example, it is put on the inner ribs 61d1 and 61d2 to thereby sandwich, in a depth direction, a pair of the lateral rib 43d2 and the inner rib 61d2 and another pair of the lateral rib 43d4 and the inner rib 61d1 of the optical box 36d by using the springs 39a and 39b as shown in FIG. 3 or 4. Likewise, they are sandwiched by the springs 39a and 39b on the opposite side.

Likewise, the four scanning type optical devices 40a through 40d are mounted and fixed to the storage member 60.

In this case, the storage member 60 has one reference pore 72a (the other reference pore is formed on the opposite side) formed therein, so that by inserting into and fixing to this reference pore 72a one reference pin 71a (the other reference pin is provided on the opposite side) protruding from the color image forming apparatus 70 to thereby determine the position of the storage member 60, thus fixing it to the color image forming apparatus 70 by a screw 73. By providing such a storage member 60, the four scanning type optical devices 40a through 40d can be replaced simultaneously, thus facilitating maintenance. Moreover, even if the color image forming apparatus 70 is mounted on an inclined surface, only outer ribs 76a

and 76b of the storage member 60 are deformed, thus leaving the light application positions of the scanning type optical devices 40a through 40d unchanged.

The following will describe a method for stacking the scanning type optical devices 40a through 40d as they are one on another and then fixing them to the color image forming apparatus with reference to FIG. 7.

The optical box 36d of the scanning type optical device 40d set at the lowest stage is mounted with one engaging fixture rib 79a and the other at the front and rear parts thereof in the light emission direction, the fixture rib 79a of which has one reference pore 77a formed therein, with the other formed on the opposite side of the optical box.

Thus, the scanning type optical devices 40a through 40d are stacked one on another according to almost the same method as described above with reference to FIG. 3, 4, or 5. Then, the reference pore 77a formed in the fixture rib 79a is fitted to the reference pin 71a (the other reference pin is provided on the light emitting side) provided as protruded on the color image forming apparatus 70 to thereby determine the positions of the scanning type optical devices 40a through 40d, thus fixing the scanning type optical devices 40a through 40d to the color image forming apparatus 70 using a screw 75. Thus, the scanning type optical devices 40a through 40d can be

fixed to the color image forming apparatus 70 to thereby prevent the optical boxes 36a through 36d from being deformed, thus avoiding the fluctuations in the light application positions of the scanning type optical devices 40a through 40d.

Next, the following will describe a method for fixing the scanning type optical devices 40a through 40d using a screw, on the basis of Fig. 8.

Likewise in the above-mentioned example, the scanning type optical devices 40a through 40d are aligned and positioned through the reference pore 77a and the reference pin 71a and then fixed to the color image forming apparatus 70 by sandwiching this apparatus 70 and one pair of the ribs 80a and 80b (the other pair is provided on the opposite side) by one pair of fixture springs 81a and 81b (the other pair is provided on the opposite side). Accordingly, likewise in the above example, the optical boxes 36a through 36d are not deformed, to permit the scanning type optical devices 40a through 40d to be fixed as unchanged in light application position. In this case, the scanning type optical devices 40a through 40d can be fixed to the color image forming apparatus also by means of adhesion or welding to obtain the same effects.

In this embodiment in particular, in a case where the folded mirror is not arranged in the scanning type optical devices 40a through 40d, there are less factors

present for causing fluctuations in the light application position even with a slight deformation in the optical boxes 36a through 36d, to thereby reduce those fluctuation in the light application position greatly, thus enabling obtaining a color image forming apparatus capable of high-accuracy printing.

Furthermore, in this embodiment, the interval (pitch) between the image bearing bodies 37a through 37d is the same as that between the scanning type optical devices 40a through 40d, so that the color image forming apparatus can be made with the minimum required number of components and very inexpensively.

Therefore, by the present invention, a plurality of optical boxes is put in a stack and integrated to thereby constitute scanning optical devices, so that these scanning type optical devices can be prevented from encountering such a phenomenon that these devices, when they are mounted to a color image forming apparatus, are deformed to be shifted in their light application positions in different directions, thus avoiding image quality deterioration due to misregistration in color to obtain a high quality color image in a stable manner.

While there has been described what is at present considered to be preferred embodiments of the present invention, it will be understood that various modifications may be made therein, and it is intended

to cover in the appended claims all such modifications as fall within the true spirit and scope of the present invention.